# Numerical Magnitude Representations Explain the "Learning Gap"

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## HYPOTHESES

1. **Chinese preschoolers are better in mathematics than American peers**
2. **This learning gap is because Chinese preschoolers have higher symbolic numerical proficiency than American peers**

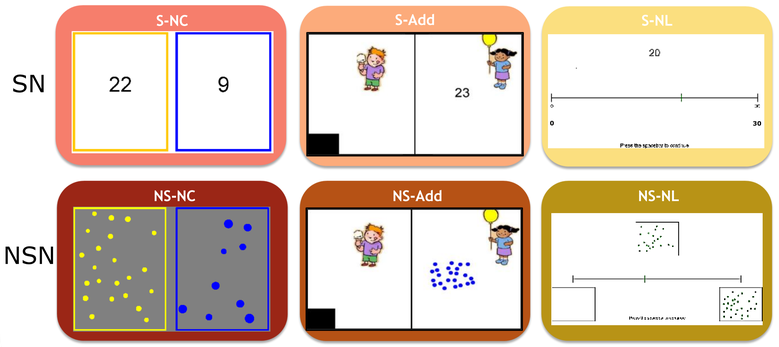
## INTRODUCTION

**Symbolic numbers:** such as number "3"
**Non-symbolic numbers**: such as "three apples"

- Previous studies documented that Chinese children in high school, elementary school, and even kindergarten out performed American peers in mathematics.
- Three hypotheses have been offered to explain the learning gap between Chinese children and American children: differences in
  - General intelligence
  - Proficiencies with non-symbolic numbers
  - Proficiencies with symbolic numbers

## METHOD

- **Participants:** 80 from CN (n=40) and US (n=40)
- **Age:** 5-6 years old
- **Intelligence Task:** digit coding task
- **Numerical Proficiency Tasks:**

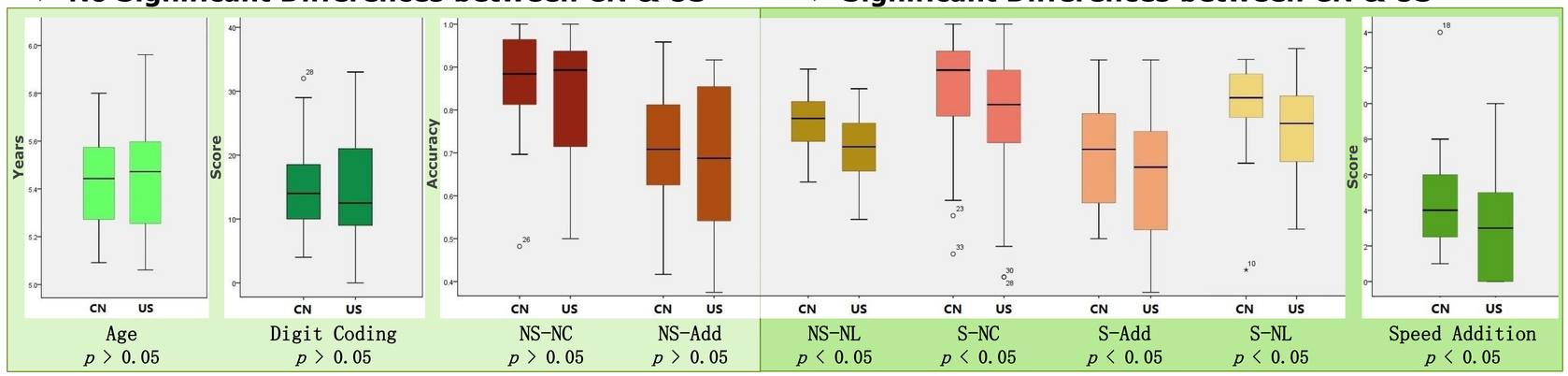



- **Mathematical Achievement:** speed addition

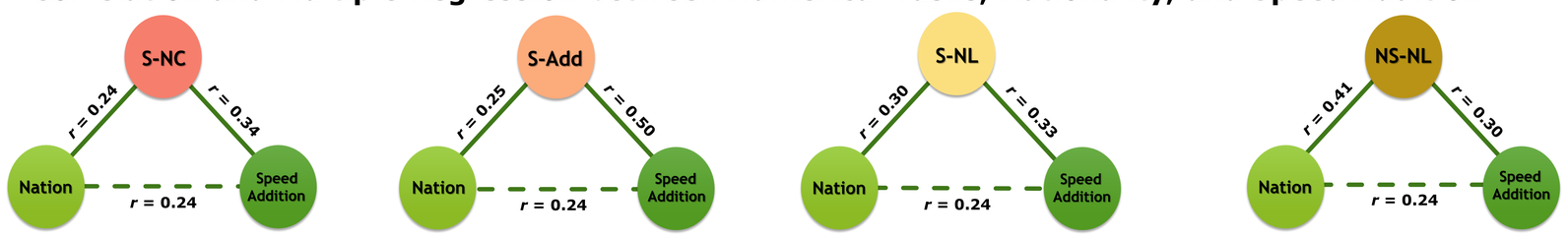
## RESULTS

➢ **No Significant Differences between CN & US**

➢ **Significant Differences between CN & US**




➢ **Correlation and Multiple Regression between Numerical Tasks, Nationality, and Speed Addition**




$\beta_{S\text{-}NC} = 0.30^{**}$ $\beta_{nation} = 0.17$ ns

$\beta_{S\text{-}Add} = 0.47^{***}$ $\beta_{nation} = 0.12$ ns

$\beta_{S\text{-}NL} = 0.28^{**}$ $\beta_{nation} = 0.16$ ns

$\beta_{NS\text{-}NL} = 0.25^{*}$ $\beta_{nation} = 0.14$ ns

## DISCUSSION

- **Results are not precisely consistent with the hypotheses: Chinese kindergartners would not outperform Americans due to higher intelligence, to higher proficiency with non-symbolic numbers, or solely to higher proficiency with symbolic numbers.**
- **Rather, a combination of symbolic and spatial numerical skills almost fully mediated the effect of nation on arithmetic performance.**
- **Current educational practice in America focuses on improving children's proficiency with "concrete" non-symbolic numbers. The current results suggests that this focus is likely misguided because American children are already as proficient with these materials as Chinese children, yet score no higher in arithmetic. Rather, a combination of symbolic and spatial numeric activities ( e.g., symbolic number line estimation) is likely to prove more effective in closing the "learning gap".**

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